

Magnetic Shift-Register Elements and Assemblies



GENERAL DESCRIPTION — DI/AN magnetic-core shift-register elements and assemblies are digital information storage devices which serve as fundamental building blocks in a broad range of data acquisition, control, and processing systems. Interconnected to provide propagation (shifting) of information from one element to the next, they can be logically organized to perform many data processing and control functions. They are asynchronous, and can be shifted at any varying bit-rate up to the maximum specified for each model. No attenuation occurs as information is passed from element to element because each is a unity-gain amplifier. Since magnetic storage is non-volatile, information is not lost when power is turned off.

The basic storage unit is the Core Transistor Register element (CTR). A complete line of standard CTR modules is available (Pages 2-4), with a wide range of operating parameters, and several convenient, modular package sizes.

A line of Core Transistor Driver elements (CTD's) is also available (Pages 2-4). Each of these units is designed with the necessary power gain and pulse standardization to provide a suitable shift-current pulse for driving a group of compatible CTR's.

Ten standard CTR's and one standard CTD, interconnected and mounted on a compact plug-in card, comprise a 10-bit Shift Register Assembly (SRA-10) which can be used as a simple serial shift register, for format conversion, or for a number of other logical functions. (See Pages 5 and 6.)

FEATURES

- Low impedance circuitry provides high noise immunity
- Non-volatile storage — data is retained with power off
- Low average power consumption — single supply-voltage required
- Encapsulation provides good heat dissipation, mechanical strength, environmental protection
- High radiation resistance — broad operating temperature range
- Small size — light weight

QUALITY AND RELIABILITY

Digital magnetic circuitry, which has been developed by DI/AN to a high degree of sophistication, is inherently extremely reliable. DI/AN magnetic elements have fewer components and fewer solder joints, and are completely encapsulated. In addition, over its many years of experience, DI/AN has developed production and testing techniques which insure optimum product performance and reproducibility from lot to lot. A concentrated quality assurance program includes life testing, component evaluation and 100% production testing. Quality control standards conform to requirements of MIL-Q-9858. RESULT: more than 8 million module hours of operation without a failure.

CTR (Core Transistor Register element)



CTD (Core Transistor Driver element)



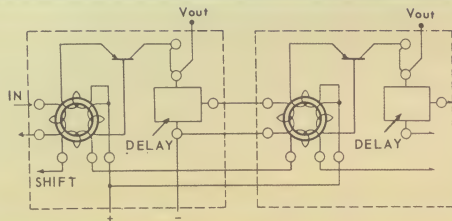
SRA-10 (Shift Register Assembly)



CTR MAGNETIC REGISTER ELEMENTS

The CTR is a basic shift-register element which utilizes a magnetic core to store a single information bit. It includes a transistor, operated as a switch, which drives a delay and impedance matching network, coupling the unit to subsequent elements. The schematic diagram below shows two interconnected CTR's.

Connections for positive output are shown. Note that no external components are required, other than interconnecting



Model Designation Code (use in ordering)

Core-Transistor Register Element (CTR)

Denotes Core-Transistor Register Element Module Package

CTR-100-P/N-12-()

Maximum Repetition
Rate (Kilobits/Sec)

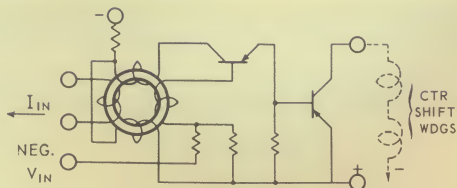
Nominal Power-Supply
Voltage



CTD MAGNETIC SHAPER-DRIVER ELEMENTS

The CTD Shaper-Driver furnishes the necessary power gain and pulse standardization to provide a suitable current pulse for shifting the compatible model CTR Shift Register Ele-

ments. The input signal to the CTD can be supplied by either a current or voltage source.



Model Designation Code (use in ordering)

Core-Transistor Driver Element (CTD)

Denotes Core-Transistor Driver Element Module Package

CTD-100-P-12-()

Maximum Repetition
Rate (Kilobits/Sec)

Nominal Power-Supply
Voltage



SPECIAL ELEMENTS AND ACCESSORIES

TWO-WAY SHIFT-REGISTER ELEMENTS (CTR 2W-100-P-12) — This circuit element is an asynchronous dynamic device accepting shift pulses at rates from 0-100KC on either of two shift lines. Each shift line controls the signal of a corresponding output, the other output being dormant.

The principal application of this logic element is in the construction of arrays having two different information paths. For example, a bi-directional shift register can be built which permits shifting digital information in either direction; right to left, or left to right, on command. A common application of the bi-directional register is a reversible ring-counter. Alternatively, groups of two-way elements may be connected in a matrix register, which permits shifting the stored words either vertically or horizontally.

The "logic potential" of this new two-way element is extremely broad... almost any arbitrary rearrangement of the data fed into a two-way register may be achieved. For instance, a word may be inverted end for end: coming into the register low order first, and, in response to a one-pulse command, be inverted so as to go out high order first.

USEFUL ACCESSORY ELEMENTS — In implementing interconnection between the shift register and driver elements described herein and external circuitry, the design engineer will find two standard accessory elements useful:

CTI input amplifiers combine the functions of power amplification and signal amplitude discrimination. Their input characteristics resemble a Schmitt trigger circuit. In conjunction with their internal delay network, they will produce constant-amplitude, constant-width output pulses, independent of input signal wave-shape or repetition rate over wide limits.

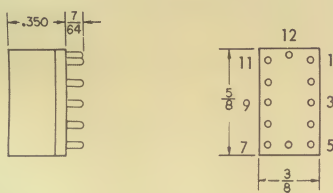
CTP elements operate as "pulse stretchers" and "pulse fortifiers". They are useful for loading several "1"s at a time into a register, for clearing or presetting a register, and for any other application in which higher pulse power and wider pulse width than normally available from a CTD driver is required.

These accessory modules are available in voltage and environmental ratings compatible with many standard DI/AN register elements. Consult the DI/AN Applications Engineering Department for specific circuit advice.

CHARACTERISTICS – CTR REGISTER ELEMENT

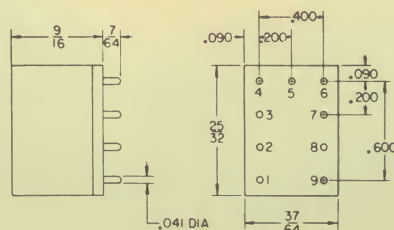
Model Designation	Operating Freq. Range kilobits/sec	Packaging & max. operating temp. (°C)					Power Supply Requirements(Nominal)			Inputs (Nominal)					
		PB	MSQ	LSQ	DSQ	LDSQ	Voltage $\pm 15\%$	Power (mw) all "ONE's" at max. Bit Rate	Power — stand by	Information					E _{in} (volts)
										Voltage			Current		
										E _{in} (volts)	R _{in} (Ω)	Duration (μ sec)	I _{in} (ma)	Duration (μ sec)	
CTR-100-P/N-6	0-100	—	55°	—	—	—	6	80	60 μ W	6*	330	5	12	5	—
CTD-100-P-6	0-100	—	—	—	55°	—	6	500	55 mw	—	—	—	—	—	—
CTR-100-P/N-12	0-100	—	55°	—	—	—	12	100	60 μ W	12*	390	3	15	5	—
CTD-100-P-12	0-100	—	—	—	55°	—	12	750	90 mw	—	—	—	—	—	—
CTR-100-P/N-12S	0-100	—	100°	100°	—	—	12	100	60 μ W	12*	390	3.5	15	4.5	—
CTD-100-P-12S	0-100	—	—	—	100°	100°	12	610	50 mw	—	—	—	—	—	+1
CTR-100-P/N-24	0-100	{ 100°	—	—	—	—	24	150	30 μ W	24*	—	—	10	4	—
			100°	100°	—	—	24	250	30 μ W	24*	820	3	15	5	—
CTD-100-N-24	0-100	—	—	—	100°	100°	24	1200	120 mw	—	—	—	—	—	—
CTR-250-P/N-24	0-250	100°	—	—	—	—	24	150	30 μ W	24*	820	1.5	15	1.5	—
CTD-250-N-24	0-250	—	—	—	—	100°	24	1500	150 mw	—	—	—	—	—	—
CTR-500-P/N-12S	0-500	—	100°	—	—	—	12	200	30 μ W	12*	180	0.6	30	1	—
CTD-500-P-12S	0-500	—	—	—	100°	—	12	1200	120 mw	—	—	—	—	—	—
CTR-500-P/N-12	0-500	—	55°	—	—	—	12	200	60 μ W	12*	180	0.5	30	1	—
CTD-500-P-12	0-500	—	—	—	55°	—	12	1200	120 mw	—	—	—	—	—	—
CTR-500-P/N-24	0-500	—	100°	100°	—	—	24	200	30 μ W	24*	390	0.3	40	1	—
CTD-500-N-24	0-500	—	—	—	100°	100°	24	1500	145 mw	—	—	—	—	—	—
CTR-750-P-12	0-750	—	55°	—	—	—	12	80	80 μ W	12*	150	0.3	60	0.4	—
CTR-750-N-12	0-750	—	55°	—	—	—	12	80	80 μ W	12*	150	0.3	60	0.4	—
CTD-750-P-12	0-750	—	—	—	55°	—	12	1800	180 mw	—	—	—	—	—	—
										*to load following register stage					

PICO-BIT®
(PB)



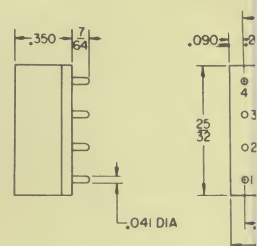
Note: Mating sockets available on order for breadboarding, etc.

MINIATURE SQUARE (MSQ)



Note: Mating sockets available on order for breadboarding, etc.

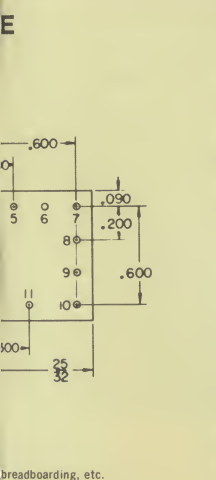
LOW SQUARE (LSQ)



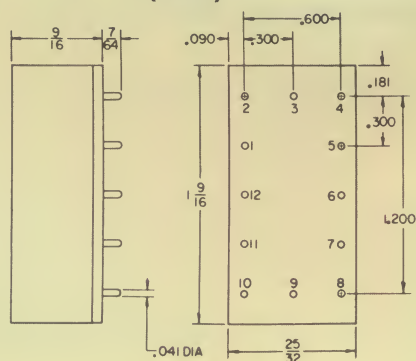
Note: Mating sockets available on order for

EMENTS AND CTD SHAPER-DRIVERS

						Outputs (Nominal)								Drive Capability (shift) Max. No. of CTR's containing all "ONE's" shifted by CTD
Trigger (Shift)						Voltage			Current					
Voltage			Current			Amplitude (volts)	1:0 Ratio	Permissible Z Load (Ω /pf)	Undelayed		Delayed			
Z_{in} (Ω)	Duration (μ sec)		I_{in} (ma)	I _Z drop across winding (volts)	Duration (μ sec)				I peak (ma)	Duration (μ sec)	I peak (ma)	Duration (μ sec)		
	—	—	250	0.3	1.5	6	30:1	1500/1000	—	—	13	4.8	—	
5	500	0.5	100	0.3	0.5	—	—	—	300	1.5	—	—	10	
	—	—	150	0.6	2.0	12	60:1	1500/500	—	—	25	4.2	—	
0	1000	0.5	100	0.6	0.5	—	—	—	185	1.5	—	—	10	
	—	—	150	0.6	1.7	12	60:1	1500/500	—	—	20	4.5	—	
0	6800	0.5	100	0.5	0.65	—	—	—	240	1.7	—	—	12	
	—	—	150	0.5	1.2	24	60:1	4000/200			20	3.0		
	—	—	120	1.5	2.0	24	60:1	3000/250	—	—	25	3.4	—	
0	1000	0.5	180	0.5	0.5	—	—	—	100	2.0	—	—	10	
	—	—	150	1.5	0.5	24	60:1	2000/200	—	—	25	1.3	—	
0	1200	0.4	100	0.6	0.4	—	—	—	200	0.6	—	—	10	
	—	—	120	0.6	0.4	12	60:1	2000/200	—	—	50	0.7	—	
0	1200	0.2	100	0.6	0.2	—	—	—	170	0.4	—	—	10	
	—	—	120	0.6	0.4	12	60:1	2000/200	—	—	50	0.7	—	
0	1200	0.2	100	0.6	0.2	—	—	—	150	0.5	—	—	10	
	—	—	150	1.5	0.2	24	50:1	3000/100	—	—	50	0.8	—	
2	1000	0.2	100	0.6	0.2	—	—	—	150	0.5	—	—	10	
	—	—	125	0.5	0.2	12	15:1	220/1000	—	—	60	0.4	—	
	—	—	125	0.5	0.2	12	15:1	220/1000	—	—	60	0.4	—	
0	2200	0.2	125	0.6	0.2	—	—	—	125	0.25	—	—	12	

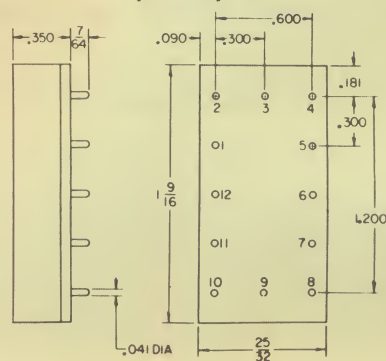


DOUBLE SQUARE (DSQ)



Note: Mating sockets available on order for breadboarding, etc.

LOW DOUBLE-SQUARE (LDSQ)



Note: Mating sockets available on order for breadboarding, etc.



SRA-10 MAGNETIC SHIFT-REGISTER ASSEMBLIES

DI/AN SRA-10 magnetic digital assemblies are basically 10-bit registers (one core per bit, requiring single-phase clock) utilizing ten standard CTR core elements, and one CTD shift-driver element. They can be used as simple serial shift-registers, for format conversion (series-to-parallel or parallel-to-series), or to implement any of the following additional logical functions: DELAY, COUNT, TIME, CONTROL, or PROGRAM. Registers may be cascaded directly, without limit, for increased storage capacity.

Adaptability to a great variety of logical functions has been achieved by bringing all significant circuit functions out to accessible tie-points on the printed-circuit board, permitting inexpensive factory modifications in production, and simple adaptations by the user.

In operation, the circuit exhibits a nominal one-zero ratio ranging from 30:1 to 100:1 depending on the particular model (see Table of Operating Characteristics, Page 6). It is inherently very tolerant of power-supply line and load regulation, accommodating variations of $\pm 15\%$ without loss of performance margins. Only one power-supply volt-

age is required, and power consumption is remarkably low — a range of approximately 100-300 milliwatts per bit at 100% duty, and approximately 5-15 milliwatts per bit on standby. Drive power requirements are also very low.

Standard power-supply voltages are 6 and 12 volts, using germanium transistors, and 12 and 24 volts, using silicon transistors with higher ambient temperature ratings. Custom designs are available on special order for an even wider range of circuit requirements.

Model Designation Code (use in ordering)

Shift Register Assembly (SRA)

Denotes Shift Register Assembly Maximum Repetition Rate (Kilobits/Sec) Nominal Power-Supply Voltage

SRA-10-100-()-12

Number of Bits per Assembly

Specify Output Polarity desired:
P = positive-going output pulse
N = negative-going output pulse

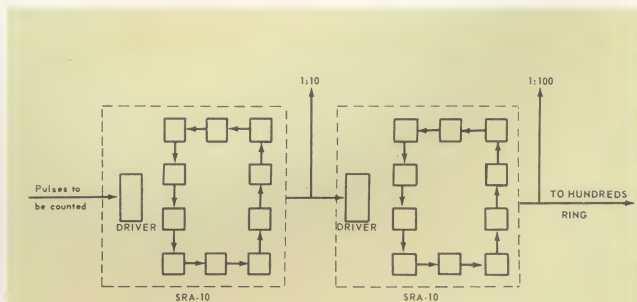
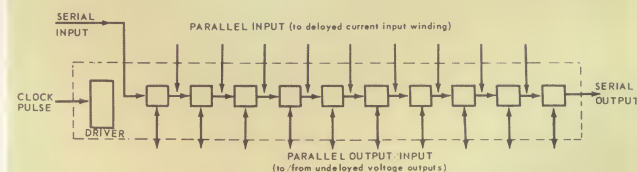
APPLICATIONS

A Shift Register of 1-10 bits in length may be constructed from one SRA-10, and longer registers, by cascading SRA-10 units without limit. Diagram at right shows all four possibilities for input-output: serial-in, serial-out; serial-in, parallel-out; parallel-in, serial-out; and parallel-in, parallel-out. In case of parallel input and output, undelayed voltage output terminals must be used for both input and output.

A Ring Counter of any scale from 2-10, and any number of rings, may be constructed by cascading SRA-10 registers. Counter may be preset by loading a "1" into appropriate stage in each ring. Diagram at lower right represents first two decades of decimal counter.

In addition to the Ring Counter, DI/AN's Shift-Register Assemblies have a variety of other applications which include:

- Parallel to Serial Converters
- Serial to Parallel Converters
- Sorters
- Pseudo-Random Code Generators
- Electrically Alterable Code Word Generators
- Pattern Generators
- Cross Correlators
- Digital Delays



SRA-10 Rack-Mounted, 21-Card Housing

Specifically designed to house up to 21 SRA-10 shift-register cards, this sturdy enclosure for standard 19" EIA rack mounting has a 3½" height and 9" depth and has built-in receptacles for simple plug-in installation.



Model SRA-1H-21



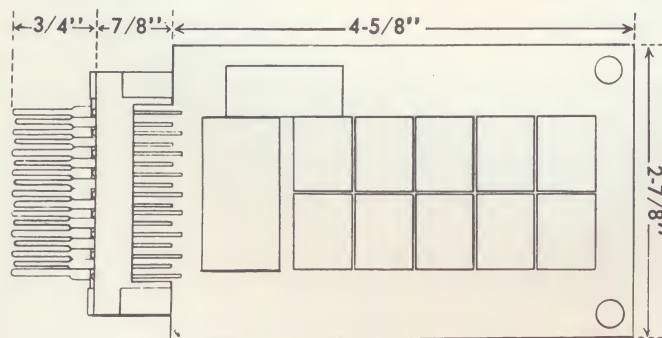
SRA-10 CHARACTERISTICS

Model Designation	Operating Frequency & Range (kilobits/sec)	Operating Temp. Range* (°C)	Power Supply Requirements (Nominal)			Inputs (Nominal)										Outputs (Nominal)			
						Information					Trigger								
						Voltage		Current		Voltage		Current							
			Voltage ±15%	Power (watts) (all "ONE's")	Power (watts) (Stand by)	E _{in} (volts)	R _{in} (Ω)	Duration (μsec)	I _{in} (ma)	Duration (μsec)	E _{in} (volts)	Z _{in} (Ω)	Duration (μsec)	I _{in} (ma)	Duration (μsec)	Amplitude (volts)	1:0 Ratio	Permissible Z Load (Ω/pf)	
SRA-10-100-()-6	0-100	—40', +55°	6	1.3	.05	6	3300	5	12	5	—5	500	0.5	100	0.5	6	30:1	1500/1000	
SRA-10-100-()-12	0-100	—40°, +55°	12	1.6	.09	12	390	3	15	5	—10	1000	0.5	110	0.5	12	60:1	1500/500	
SRA-10-100-()-12S	0-100	—55°, +100°	12	1.6	.05	12	390	3.5	15	4.5	+10	6800	0.5	100	0.65	12	60:1	1500/500	
SRA-10-100-()-24	0-100	—55°, +100°	24	2.5	.12	24	820	3	15	5	—10	1000	0.5	100	0.5	24	60:1	4000/200	
SRA-10-500-()-12	0-500	—40°, +55°	12	3.2	.04	12	180	0.5	30	1	—10	1200	0.2	100	0.2	12	60:1	2000/200	
SRA-10-500-()-12S	0-500	—55°, +100°	12	3.2	.12	12	180	0.6	30	1	—10	1200	0.2	100	0.2	10	60:1	2000/200	
SRA-10-500-()-24	0-500	—55°, +100°	24	3.5	.08	24	390	0.3	40	1	—12	1000	0.2	100	0.2	24	50:1	3000/100	
SRA-10-750-()-12	0-750	—40°, +55°	12	2.6	.18	12	150	0.3	60	0.4	—10	2200	0.2	125	0.2	12	15:1	220/1000	

*NOTE: Full duty cycle can be de-rated to accommodate somewhat higher operating temperatures than specified if required. Contact DI/AN for details.

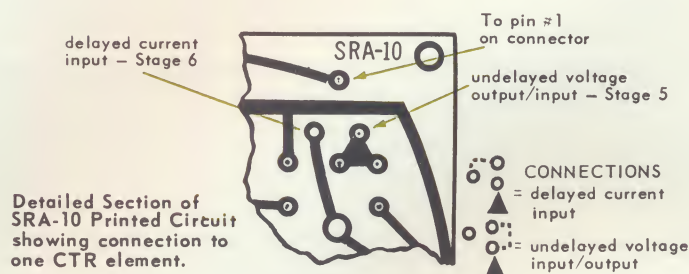
MECHANICAL CHARACTERISTICS — Size: 2 $\frac{7}{8}$ " x 5 $\frac{1}{4}$ ". Connector: Elco 17-pin Type 7001-5-1. Printed Wiring Board: epoxy glass $\frac{1}{8}$ " thick. All circuit elements mounted through eyelets to printed board. Printed boards fit 0.800" on centers; 21 boards fit standard DI/AN chassis Model SRA-1H-21. Grommets for hook to remove cards. Cards have clear edge for track mounting.

CIRCUIT CONNECTIONS — The serial input and output of the SRA-10 are permanently wired on the printed circuit board. The voltage output of the tenth stage is also printed.



Provisions are made to bring out the other parallel inputs and outputs. The total of such inputs and outputs which may be used at any one time is limited to 11 by the connector. Any stage may have both parallel input and output connected. The choice of parallel inputs and outputs can be prewired by DI/AN or by the customer. This is done by soldering a jumper wire between eyelets on the printed board, as shown below.

The SRA-10 is complete with power-supply bypass capacitor and mating plug-in connector.



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